FINAL PROJECT REPORT FORMAT – OPTIMUM DESIGN COURSE

Final written report, a very important component of the course project, is due by noon on Wednesday December 24, 2016. Each group is required to submit a single hard copy of (with a hard front cover page and hard back page, with a professional spiral or tape binding of the report – do not just staple) your project report. Please make a copy of the final report for yourself before submission since I will not return the report back to you. You must submit an electronic copy of your entire final report, in a single pdf file, and submit it to a.nagib@alexu.edu.eg . With the hard copy report, you must also provide a CD, attached to the inside cover of the last page of your report, that will include a copy of the report (MS Word) and all your program files (Matlab, Excel, see below), Power Point presentation slides. Note that the submitted final report must follow closely the instructions given here. Your report will be partly graded based on how closely you follow these instructions.

Starting with the cover page: give a title for your project problem together with your names, course name, semester (Fall 2011), and submission deadline date of 12/24/2016 -- all centered. The final report must be typeset with a 12 point Times New Roman typeface on an A4 paper (single spaced with one-inch margin all around), page numbered, and have the sections as listed below:

Table of Content (with page number for all sections/subsections)
Abstract (about 100-150 words)

1. **Introduction and Literature Survey.** Provide a motivation, short overview of some related and relevant technical literature and the overall goal of your project.
2. **Problem Definition and Formulation**
   - **2.1 Problem Definition.** Explain what the problem is. It is important that you define the problem clearly. I encourage you to use figures/pictures (here and elsewhere in the report) to clarify your points.
   - **2.2 Assumptions**. Itemize your main assumptions and explain why each assumption is made.
   - **2.3 Formulation**. Provide a description in words and then follow by a mathematical formulation of your model (that is, for each objective and constraint function). Summarize the derivations in this section but provide your long derivations in Appendix III (see below). At the end of this section, provide the formulation of the entire optimization problem in an "all-at-once" format (i.e., formulation of the final objective and constraints altogether). Clearly differentiate and identify design variables which are being optimized and parameters which are fixed during an optimization run. I highly recommend that you use x_i, i=1,…,n, (n is total number of variables) for design variables and use other symbols for parameters.
3. **Methods, Results and Discussion**. Initially, formulate your optimization project problem as a single-objective optimization problem with the other objective function treated as a constraint together with all other constraints in the problem. I am expecting that you solve this single objective optimization problem by two different single-objective optimization methods. One of these approaches should be based on a technique written by your group in Matlab, e.g., by a penalty method, by Augmented Lagrangian Method, or perhaps even by solving optimality conditions -- this last approach is not recommended but OK if you decide to use it! The other method can be a canned approach from the Matlab's optimization toolbox (e.g., fmincon).

Tabulate your results (i.e., please give (for single objective case) both initial and optimized values for objective, constraints AND particularly variables: their values at the initial point and at the optimum) from both techniques side-by-side and discuss them -- provide physical interpretation as to why the results do (or do not) make sense. Next, formulate your project problem as a two- (bi-) objective optimization problem. I am expecting that you solve your bi-objective optimization problem by two different bi-objective methods and compare the results. These two methods can be from a canned multi- (bi-) objective approach from Matlab, a bi-objective approach that you will develop based on the single objective approach above (i.e., your own single-objective or canned single-objective -- from Matlab). For comparison, graph your Pareto solutions from two methods and also tabulate a few select solutions from the Pareto set (with the value of design variables and objective functions/constraints) and discuss the results. Again, justify whether or not these solutions make sense from an engineering design point of view.

4. **Parametric Study**. For the single objective model, take several (say 2 or 3) important design parameters (for example, modulus of elasticity, permissible stress, applied force, or other parameters that you consider to be important) and change them within a range and obtain a series of optimized solutions. Show these solutions graphically to demonstrate the changes in the optimized objective (and variables) values as a result of a change in the design parameter. A parametric study for the two-objective solutions is also desirable but *optional* for the project report.
5. **Conclusion**. Provide about 100-150 words for your concluding remarks: what are the highlights of this projects, strengths and weaknesses of the optimization model, appropriateness of assumptions, insights the results provide, whether the results are meaningful and/or realistic, and finally the recommended/possible future extensions.
6. **Cited References**. List only references that you cite in the main body of the report.
7. **Nomenclature.** Define ALL symbols used in the formulation with their units, and numerical values for the parameters that were fixed. Clearly identify (preferably separate (the design variables versus design parameters.

Appendix I. Provide a sample problem description file (e.g., in Matlab, or in Excel format)-objective and constraints and sample results.
Appendix II. Provide a full computerized code of your single-objective optimization program written in Matlab, e.g., the ALM code written in Matlab. Make sure you have comments in your program describing key sections of your software. Do the same for a sample bi-objective case.
Clearly mark and distinguish between these codes with identifiable names and titles.
Appendix III. Give long derivations here -- can be a hand-written document or a copy of it!
Appendix IV. Provide a copy of your midterm and final oral presentations (in Power Point format with your slide notes for each slide shown---slide on the top and notes at the bottom for each slide).
Finally (and again): Provide an original copy of ALL your program files (e.g., Matlab, Excel), and Word file (again clearly labeled) of your report in a CD attached to the inside cover of the last page of your report. Please clearly organize the CD so that location of different files is easy to find. Also, provide a single pdf copy of your ENTIRE report (all of the above-mentioned items) in the CD.